Distr.
LIMITED

E/ECA/ENV/32
8 October 1986

Original: ENGLISH

UNITED NATIONS

ECONOMIC AND SOCIAL COUNCIL

ECONOMIC COMMISSION FOR AFRICA

Fourth Meeting of the Joint Intergovernmental
Regional Committee on Human Settlements
and Environment

Addis Ababa, Ethiopia, 9-13 February 1987

LC/NAIROBI

DEVELOPMENT OF ENVIRONMENTAL TRAINING FOR TECHNICIANS ON MARINE POLLUTION, COASTAL EROSION AND DEPLETION OF MARINE RESOURCES

I. Introduction

1. The protection and preservation of the African coastal and marine environment is an obligation of member States of the Economic Commission for Africa. At present three programmes exist within the United Nations system to assist African countries to carry out their obligations for monitoring marine pollution and resources depletion in the African coastal and marine environment. These programmes are:

(i) The UNEP Regional Seas Programmes which are implemented on a subregional basis with inter-agency support programmes including that of ECA, for collaborating member States to agree on related conventions and protocols to protect their marine environment;

(ii) The ECA/UNESCO joint project on Development of Marine Science and Technology in Africa, and

(iii) Various ECA projects relating to the convention on the Law of the Sea, part XII - Protection and Preservation of marine environment.

2. Four of the ten UNEP Regional Seas Programmes concern the protection and preservation of the African coast and marine environment, namely the Mediterrannean, the Red Sea and Gulf, the West and Central African and the East African regional seas programmes. Each regional seas programme has an Action Plan to deal with problems such as monitoring marine pollution, control of coastal erosion and development, and conservation of living marine resource. The Action Plans are approved by the governments in the subregion who also adopt a convention and protocols and agree on financial arrangements to implement the programme.

3. Besides, the three priority areas identified above as common to the regional seas Action Plans, other immediate areas usually dealt with are:

(i) Institutional arrangements for co-ordination of national contingency plans for marine pollution emergencies,

(ii) supporting measures such as manpower training, information exchange and legislation for marine affairs;

(iii) technical studies on specific topics such as oil pollution, river inputs industrial sources, marine pollution, and

(iv) environmental impact assessment and management of coastal development projects.

4. The Economic Commission for Africa is interested in the area of manpower training on marine technicians as one of the areas identified above. This implies developing national technical capabilities of African countries for a systematic monitoring of pollution in the coastal marine environment as well as developing the manpower resources.

both professional and technical, necessary to implement the programme. To develop a reliable management programme for the African marine and adjacent coastal environment, the assessment component must be based on comparable methodology for scientific data collection during monitoring, analysis and for the synthesis of the reports by each coastal African country. This demands regional co-operation for an intensive training programme to close the gap between what needs to be done and the availability of technical trained manpower.

5. To prepare training guidelines for technicians to be trained to carry out monitoring activities for marine pollution and resources depletion in the African coastal marine environment, ECA hired a consultant in 1983 with the following terms of reference to develop the guidelines:

(i) Investigate the availability of technician training institutions and trained technicians in marine sciences in African coastal states

(ii) To prepare guidelines and principles on which to base the training of middle-level technical manpower to carry out national programmes and projects for the protection and preservation of the marine environment and the socio-economic development of the coastal areas; and

(iii) To assess the training needs of African coastal States to implement the provisions of the Convention on the Law of the Sea with particular reference to UNEP Regional Seas Programme working coments. UNESCO's Report No. 5 on syllabus for training marine technicians (1979).

The purpose of this document, therefore, is to report on the findings of the study and propose follow-up activities.

II. Highlights of the study

6. Three major environmental problems of the coastal areas of the African region were identified. These are:

(a) Pollution

(b) Coastal Erosion and Siltation

(c) Resource Depletion

The extent of each of these problems in any of the African coastal states depends on a number of factors such as geographical and geomorphological influences type and amount of potential living marine resources and the level of industrial development.

(a) Water and marine pollution

7. In addition to aesthetic impairment, the various transfer routes of water pollutants into the marine environment can lead to the following types of pollution in general; namely: (i) aesthetic, (ii) physical (iii) chemical (iv) microbial and (v) thermal pollution.

8. Aesthetic aspects of marine pollution comprise, for example of odour nuisance from anoxic coastal waters especially near mangrove swamps, and the littering of beaches, bays and estuaries with bottles, plastics, food containers, metal cans, old tyres, etc, thereby imparing or obstructing the use of sea water and causing a reduction in amenities.

9. Physical pollution pertains to silt and sediment load carried into estuaries and the coastal environment by rivers, rendering sea-water turbid, creating ecological stress on fauna and flora (especially on coral reefs) and causing hindrance to coastal shipping activities.

10. Chemical pollution is a direct consequence of the introduction by various pathways of toxic inorganic chemicals such as the heavy metals (mercury cadmium, chromium and lead) and persistent toxic chemicals such as chlorinated pesticides herbicides, insecticides and polychlorinated biphenyls (PCBs) which could be accumulatively toxic to marine organisms when present at high concentrations, or cause devvstating physiological disorder and behavioural responses when present at sub-lethel concentrations. Wildlife and man suffer harmful health effects which sometimes manifest themselves through reproductive failures due to the ingestion of marine biota polluted with toxic chemicals, including petroleum hydrocarbons.

11. Microbial pollution is caused by sewage pollution of coastal waters and associated biota, resulting in contamination of coastal waters, fish and shellfish with epidemic-causing pathogenic organisms such as Salmonella typhi and vibro cholerae. Serious health risks are posed to man through body contact with such polluted water in bathing or swimming and by ingestion of raw or half-cooked contaminated seafoods caught in such waters.

12. Thermal pollution results from the discharge of thermal power station cooling water effluents or hot effluents from industrial complexes usually with high temperatures of 40° - 60°C into estuaries or lagoon waters. Fishes in tropical waters are known to live just below their upper lethel temperatures limit (30°C) for their survival, so that any addition of heat energy into the marine environment is detrimental to their survival. Heat could result in fish kills or in altering natural behaviour of stressed biota. Although fish kills have been recorded generally near the source of the hot effluents, they are often due to the biocides used in the cooling systems. "thermal pollution" does not appear to be a significant marine problem, particularly since there is increased growth in warmer water which may well compensate.

Sources of marine pollutants

13. In almost all the coastal sub-regions of Africa, the primary sources of pollution are:

(i) Sewage discharge

(ii) Domestic/commercial waste discharge

(iii) Industrial waste outfalls

(iv) Agricultural wastes disposal

(v) River run-off and land-based marine pollution

(vi) Mining activities (metals and non-metals)

(vii) Marine based and oil pollution

(viii) Radioactive discharges from nuclear installations

Sewage discharge

14. The materials of concern in sewage are phosphates nitrates (and ammonia) heavy metals and unfortunately sometimes pathogenic bacteria and viruses. Certainly nitrates and phosphates (along with silicates) are the vital nutrients of the sea that ultimately produce the seafood that man so dearly relishes. Along beaches, sewage is a major problem both for aesthenic reasons and because of the increasing possibility of disease.

Domestic/commercial waste discharge

15. Undoubtedly, domestic sewage is the most common source of pollution in African coastal waters. It is discharged, untreated from almost all the coastal towns in the region and causes pollution in many cases. There are relatively few sewage treatment plants in the region, and in some cases where they exist they are often overloaded and in bad working order. The presence of faecal coliform (Eschetichia coli) and faecal streptococci (Streptococcus faecaelis) in water and the sediment, is a hazard to health as these organisms get ingested into the body of filter feeder organisms, bottom dwelling fish, prawns and bivalves, which make them unfit for human consumption. Such pollutants arise from human and non human faecal matter and they constitute an "indicator bacteria" group.

Industrial waste outfalls

16. Pollution problem created by sewage, is a common environmental problem that affects most countries in the Africa region, whilst industrial effluent problems problems are restricted to a few countries. Industrial wastes from a variety of sources (breweries, cement factories, slaughter houses tanneries, fertilizer factories, cotton and textile factories, sawdust from the furniture factories etc) are discharged into the sea either through rivers or directly. In some countries with oil refineries, oil pollution of the coastal waters by oily water discharges is inevitable, and where the discharges go into lagoons, the problem is particularly serious.

Agro-chemical pollution

17. Pollution from agricultural activities is inevitable in a region where agriculture is of paramount importance and its development is vigorously pursued towards the goal of food self-sufficiency and export crop earnings. Many of the countries

concerned use appreciable quantities of insecticides, pesticides and fertilizers such as DDT, aldrin and NPK respectively. They constitute an important source of pollution from factories where they are produced and from drainage and run-off from farm land via the rivers to the sea. Some of them are fairly stable and non-biodegradable, hence they persist in the water as pollutants. For example, chlorinated hydrocarbons find their way thorugh various pathways (largely through the atmosphere) to the ocean. Their threat to the marine biota lies in their toxicity (indeed that is the purpose of pesticides) and their persistence. Once broken down into their components (chlorine, hydrogen, carbon, oxygen) they would be completely innocuous in sea water. Unfortunately, the degradation process is extremely slow, and some scientists fear these substances may even poison the organisms responsible for their degradation in the ocean. If true this would be a very serious problem.

River run-off and land-based pollution

18. Several countries are actively exploiting their forest resources for timber and timber products for exports. In many cases, the river system is used to transport the logs to coastal ports for further processing or for direct export. In some instances, logs break free from the rafts and are to be found later, either floating at sea or stranded on the coastal beaches. In other cases where the logs are used in the manufacture of veneers and plywood the wastes are discharged into the coastal waters as is generally the case for other industrial effluents.

19. Another problem which can be created as a result of timber exploitation or simply the clearing of forest areas for agricultural purposes is soil erosion. The soil is washed into the rivers and carried to the coast where it settles in the calmer waters. The result can range from interference with navigation, direct effect on fisheries through increased turbidity and silting at the bottom. These are liable to be particularly acute in mangrove swamp areas such as those found along several parts of the coast of many African countries. Siltation of harbours and shipping canals are already recognised as a serious problem, since it has been greatly enhanced by deforestation over the past decades in several coastal African countries.

Mining activities

20. Mineral exploitation is of major importance in several African countries and as the waters used for washing are usually discharged without prior settlement the fine materials eventually at the bottom in the adjacent coastal waters causing an accumulation of silt and permanent, increased water turbidity. In most cases the fine materials contain considerable amount of mineral wastes (mercury iron, copper, etc.) which enter the sea from mining activities in these countries endangering marine life and human health through poisoning and other toxic effects.

Marine-based and oil pollution

21. With increasing numbers and sizes of tankers travelling through the Atlantic Ocean, the Indian Ocean and the Mediterranean Sea, oil spills and oil contamination of the beaches have caused near serious pollution problems at tourist sites along many African coasts. Oil pollution risks also include collisions or groundings of oil-laden tankers and operational discharge from tankers in ballast condition; some contamination of oil from the washing of oil tankers has also been observed on African coastal beaches.

22. The main sources of oil pollution, especially along the West African Coast and the Mediterranean include:

(i) Bullasting/deballasting operation of tankers,
(ii) Discharge of oily bilge-wate[illegible] tankers,
(iii) Tanker washings,
(iv) Refinery effluents,
(v) Discarded lubricants and other oils from ships
(vi) Accidents to tankers and other vessels,
(vii) Off-shore exploration and exploitation
(viii) Accidents to pipelines and terminals at ports,
(ix) Natural seepage of oil into the sea, and
(x) Atmospheric rain-out.

23. Specifically, marine-based pollution are due to the following activities namely:

(i) Maritime and oil tanker traffic causing oil pollution problems at the shipping routes,
(ii) Exploration and exploitation of sea-bed resources for oil and minerals at the EEZ,
(iii) Sand and coral mining for building materials from off-shore coral reefs,
(iv) Coastal construction and dredging in the construction of new ports jetties and ferry landings,
(v) Ocean dumping of radio-active wastes and other dangerous and toxic chemicals.

24. Since oil pollution is widespread along the Atlantic and Mediterranean coasts the immediate damage is on sea birds, and on mussels and oyster beds. Adult fish usually survive, but may have attained oily flavour that makes them unmarketable. Oil spills often affect marine organisms by coating the gills and hence limiting the wxygen exchange with the surface. Ingestion of volatile paraffin, olefin and aromatic hydrocarbons can cause functional alterations. Certain aromatic constituents of oil are also carcinogenic. In the economic sense, the greatest damage is probably to tourism in Africa which generally have coastal infrastructure.

Radioactive pollution

25. As nuclear research increases, so will the amounts of radionucleoids being released into the oceans increase. With their long residence times they will remain contaminants for many years. Nuclear research is not yet very evident in most of the countries of the African coast, but the effects of such activities in Southern Europe (France, Spain, Italy, etc.) are beginning to become evident in the Mediterranean subregion.

26. Radionuclides are not foreign materials in sea water. Natural radionuclides which emit all three types of radiation found in uncortainated seawater. Even after massive atmospheric nuclear weapon tests, which release for more radioactivity than the total nuclear power programme, only a small fraction of the radioactivity in the ocean derives from man. In marine organisms, moreover, it is clear that the major contributor to the radiation does is usually the naturally occuring alpha-emitter polonium-210. There has been increasing concern about polonium, but the present levels of this element in the marine environment again are very low compared with the levels of natural radionuclides.

(b) Coastal erosion and siltation

27. Erosion can be considered as a special case of negative pollution in which the living soil is lost from the earth's surface which becomes bare of plant and animal life. Siltation results from erosion of topsoil in inland areas. Soil erosion generally follows periods of heavy rainfall when the rivers often overflow and water runs overland carrying soil with it to the sea. The effects are greater during flash floods when rains follow a long dry spell during which the soil has already been loosened. Intensive grazing by livestock and a poor choice in crops can also lead to erosion. Erosion of the coastal areas by heavy wave action often leads to the destruction of tourist beaches by the removal of the sand leaving a rocky beach covered only with pebbles. Coastal reefs can act as a barrier against erosion of the beaches by waves.

28. The retreat of the coastline is a problem arising from erosion by waves in Ghana and Togo. Siltation may be a way of counteracting this! However, siltation results in an increased amount of nutrients entering the sea which leads to excessive algal growth, and damage to coral reefs as the turbid water reduces light intensity and the fine particles smother the corals growth with adverse effects on the coastal nursery frounds for fishes. Furthermore, the building of dams across naturally flowing large rivers decrease the rate of flow downstream and it reduces nutrient concentrations in estuaries and coastal waters which decreases the number of plankton blooms and fish landings.

(c) Resource depletion

29 The potential resources of the African region are diverse. Man has not failed to put most of them to economic and social uses for example: land for cultivation and settlements, extraction of timber from forests, utilization of fauna as food and

for recreation, use of beaches and lagoons for recreation extraction of terrestrial and marine life forms for decoration and so on. Concerning the depletion of living marine resources, the most important biotic factor is no doubt man himself. Through his ability to occupy and utilize a wide range of terrestrial ecosystems and species man has been able to change whole ecosystems with far-reaching, frequently deleterious effects on the organisms living there.

30. The impact of excessive deforestation of humid forests on depletion of marine resources can be seen in coastal West African countries where shifting cultivation and deforestation for timber export and for fuelwood energy supply expose the fragile tropical soils to water erosion during the long rainy season. Also, overstocking with livestock in savanna regions has led to severe erosion of the top soil. The soil is carried down to the coast and into the marine environment resulting in the silting up of lagoons and estuaries to form mangrove swamps, and the killing of coral reefs. The ultimate effect on the marine environment, is loss of fisheries productivity due to lack of growth of the algae and coral polyps, upon which fish and other organisms depend for food, which is dependent on clean and clear waters.

31. When not carefully studied and planned, large scale hydro-agricultural projects involving irrigation works and flood control projects have adverse impacts on ecosystems and biota downstream especially in deltas and nearshore marine ecosystems. It has been observed, for example that sardine productivity in the Mediterranean sea off Egypt has declined since the impounding of the river Nile by the Aswan Dam, and so has the fertility of the Nile Delta itself. The Cabora Bassa Dam (1975) on the Zambezi River, Mozambique, has reduced the river flow and disasterrous flooding regimes that used to be frequent downstream and at the delta; but a reduction in shrimp productivity occurred inevitably while salt water comes as far as 80 km upstream now.

32. The various types of pollution sources and effects discussed earlier account in part, for much of the depletion of the living marine resources of the region. It was also shown by the above examples how unplanned hydro-agricultural and other coastal development projects adversely affect the ecosystem and, ultimately lead to depletion of the associated living resources. Another source of depletion is related to over-exploitation of these resources, e.g. over-fishing in West Africa. Natural disasters and acts of war (including vandalism with the use of dynamite) also contribute in a significant way in some countries, to the depletion of marine resources.

III. Training needs for national development in marine sciences

33. The problems of pollution and living resources depletion in African coastal waters and marine environment have been shown to be significantly important in the context of socio-economic development. It is also abundantly clear that the coastal zone and the near-shore environment in the region have potential resources for exploitation such as, fish-stocks, possibilities of mariculture heavy minerals and evaporites and tourism, etc. But the marine resources of Africa still have a great potential for economic development.

34. For purposes of protecting and preserving the coastal and marine environment and in order to do these through monitoring pollution and depletion of resources it is necessary for the countries concerned to have trained and competent personnel who are fully equipped with the knowledge skills and expertise to carry out the required tasks. Indeed African countries as part of their development objectives are expected to rationally exploit available natural resources (including coastal and marine resources) to the optimum level, so as to provide maximum benefit to their peoples. To attain such an objective, it is essential to create and develop a technical manpower of well-trained scientists and technicians in the region.

35. It is well known that one of the greatest problems in the developing countries in general, and African in particular, is the acute shortage of middle-level manpower, especially in the fields of science and technology. The term 'technician describes the various types of personnel who come between the highly specialized professional or technological experts and the craftsman, who have the skill and knowledge necessary to apply and control technical practices that have been defined by technologiest'. Thus the term covers wide sectors of development including engineering health, agriculture, commerce and industry as well as education and science, not forgetting marine science and technology.

36. Surveys which have already been carried out in the area by an ECA/UNESCO project confirm that none of the African countries concerned has adequate expertise and facilities required to carry out the development of their marine science and technology. The greatest need in pollution monitoring and control is for technicians. The shortage of technicians is therefore a great obstacle to progress in any programme of monitoring pollution and control. What is required in the first place, are very strong educational training and research programmes in marine science and technology to strengthen and generate the indigenous scientific and technological manpower that could provide the marine administrators and decision-makers with the basic data and scientific principles necessary for the best management and development of their local marine environment.

37. Intensified subregional and regional training of scientific and technological personnel are decisive factors for Africa's economic and social development. The development of technical training must therefore be done in close agreement with economic development plans and in collaboration with the economic and social sectors concerned.

38. Environmental training of technicians for development will provide the knowledge skills and techniques needed to handle and solve environmental problems, including monitoring and control of pollution, to conserve and manage natural (including coastal and marine) resources and generally to protect and restore the quality of environment.

39. It has become clear from the study that, in programming training activities in marine pollution, coastal erosion and depletion of marine resources the following must be borne in minds that:

(i) the majority of national institutions in Africa are inadequately equipped and they lack the facilities to carry out the provisions of the Convention of the Law of the Sea. Such institutions dealing with marine science and technology are very inadequate and unevenly spread throughout the coastal countries of the region, consequently the number of technicians available for the defined tasks is abysmally small;

(ii) the state of national legislation for the protection of the African coastal and marine environment varies from one coastal state to another but in general there does not seem to be an adequaterly or fully developed system of legislation for this purpose in most of the countries concerned in fact it is doubtful whether practical enforcement of such laws takes place to any reasonable degree in those states having the basic legislative provisions for the protection of the marine environment.

(iii) training has to be directed on the technical aspect of the subject matter and towards effective policies for environmental legislation in the African countries, for developing environmental standards and for quality controls have to be established, coupled with scientific monitoring of pollutants in the environment;

(iv) environmental laws are required to regulate the level of pollutants permissible in the air, water and soil as well as the level of liquid and solid wastes in coastal and marine areas of the region. The law should make provision for setting up national standards laboratories for the monitoring of pollutants and contaminants in food, drugs and animal feed.

These pre-occupations do justify the need for the training of competent technicians to perform the complicated though routine analyses required. Effective pollution control demands the laws of legal draughtsman, the setting up of institutional mechanism for monitoring, a training component as well as a well spelt-out quality control policy for all development planning activities in the country.

IV. Suggestions for follow-up activities

40. (i) ECA hopes that this activity on the development of environmental training for technicians on marine pollution will sensitize member States to develop comprehensive programmes and strategies for training technicians in monitoring pollution and the depletion of living resources in the coastal and marine environment;

(ii) Guidelines on the Development of Environmental training for technicians on marine pollution, coastal erosion and depletion of marine resources in the Exclusive Economic Zone (EEZ) will be developed based on the study and with the cooperation of interested United Nations organizations (UNESCO, IMO, FAO, UNEP), to be published and made available for the use of member States and interested institutions,

(iii) ECA's report to the Third Joint Intergovernmental Regional Committee on Human Settlements and Environment 22-26 July 1985 (document E/ECA/HUS/ENV/3) regarding the report of ECA/UNEP training workshop for the incorporation of environmental components into the training programmes of ECA-sponsored institutions did indicate that programmes will be developed as the need arose. This is one of the areas of priority;

(iv) In order to finalize the above-mentioned guidelines, ECA is requesting all member States to up-date and complete the information being compiled in Annex I on Institutions for Marine Science and Technology in Africa, involved with monitoring of pollution, depletion of living marine resources and research on coastal erosion.

ANNEX I

INSTITUTIONAL RESOURCES FOR MONITORING POLLUTION AND DEPLETION OF LIVING RESOURCES IN THE COASTAL AND MARINE ENVIRONMENT IN AFRICA

	COUNTRY	NO. OF INSTITUTIONS	NAME OF INSTITUTIONS (BY CODE)	RELEVANT PROGRAMMES (Research/Training)
1.	ALGERIA	1	ALG (A)	Marine ecology and pollution studies: postgraduate training in oceanography.
2.	ANGOLA	2	ANG (A)	Research in biology and biological oceanography Training course in aquatic ecology.
3.	CAMEROONS		ANG (B)	Applied research in biology, physical oceanography, chemistry and geology.
3.	CAMEROONS		CAM (A)	Studies in marine sciences, oceanography and marine biology.
4.	CONGO		CONG (A)	Studies in physical chemical and biological oceanography towards fisheries development.
5.	DJIBOUTI		DJI (A)	Biological Oceanography
			DJI (B)	Studies in biological and chemical oceanography
6.	EGYPT		EGY (A)	Research and Training in physical, chemical and biological oceanography
			EGY (B)	Oceanographic studies oriented towards fisheries problems: Training courses for scientists and Technicians in hydrobiology, hydrography and fishery biology.

COUNTRY	NO. OF INSTITUTIONS	NAME OF INSTITUTIONS (BY CODE)	RELEVANT PROGRAMMES (Research/Training)
		EGY (C)	Research on all aspects of Environmental pollution Postgraduate Training in Public Health.
		EGY (D)	Studies in fisher biology limnology fish culture hydrobiology biochemistry and other activities dealing with inland water including Training courses for scientists and Technicians.
		EGY (E)	Environmental aquatic pollution.
		EGY (F)	Sanitary Engineering Research
		EGY (G)	Research and training in oceanography marine biology fisheries and acquaculture.
7. GABON	2	GAB (A)	Marine Sciences oceanography and marine biology
		GAB (B)	Marine Pollution studies.
8. GAMBIA	1	GAM (A)	Exploratory research on the river Gambia
9. GHANA	1	GHA (A)	Pure and Applied Research and Training in physical biological and chemical oceanography and fisheries oriented towards fisheries development.
10. GUINEA	2	GUIN (A)	Marine biology research
		GUIN (B)	Research in Oceanography and Heliophysique
11. Ivory Coast	3	IVO (A)	Oceanographic and hydrobiology research studies of the dynamics of the waters of the Gulf of Guinea.

COUNTRY	NO. OF INSTITUTIONS	NAME OF INSTITUTIONS (BY CODE)	RELEVANT PROGRAMMES (Research/Training)
		IVO (B)	Research and Training in oceanography, Aquaculture and Fisheries.
		IVO (C)	Studies on terrestrial ecology and hydrobiology.
12. KENYA	3	KEN (A)	Fisheries research with provision for physical, chemical and biological oceanography.
		KEN (B)	Research and Training in marine science.
		KEN (C)	Analysis of food, drugs and chemicals, water and sewage to assess quality for public health purposes trace metal analysis in marine produce.
13. LIBYA	2	LIB (A)	Baseline survey work of the Libyan mediterranean coast Training in Environmental studies.
		LIB (B)	Marine Fisheries Research.
14. MADAGASCAR	3	MAD (A)	Training and research in Oceanography.
		MAD (B)	Training and research in physical oceanography and hydrography.
		MAD (C)	Applied research in marine science and oceanography.
15. MAURITANIA	1	MAURITAN(A)	Research on oceanography.
16. MAURITIUS	2	MAURITI (A)	Biological Research
		MAURITI (B)	Study of the ecology of marine invertebrates.

COUNTRY	NO. OF INSTITUTIONS	NAME OF INSTITUTIONS (BY CODE)	RELEVANT PROGRAMMES (Research/Training)
17. MOROCCO	4	MOPOC (A)	Applied Fisheries research and training.
		MOROC (B)	Geological and Geochemical research of the continental shelf.
		MOROC (C)	Research on marine hydrobiology.
		MOROC (D)	Biological oceanography.
18. MOZAMBIQUE	3	MOZ (A)	Marine Biology and oceanography Research.
		MOZ (B)	Basic and Applied research in biology especially on fish molluscs and fisheries.
		MOZ (C)	Fishery biology: stock assessment acquaculture and chemical oceanography.
19. NIGERIA	4	NIG (A)	Applied research in biological, chemical and geological oceanography and fisheries.
		NIG (B)	Marine biology and ecology of the lagoons and estuaries, related to fisheries development and pollution monitoring and control
		NIG (C)	Applied research multidisciplinary systems of aquaculture of selected species of finfish and shellfish.
		NIG (D)	Basic and applied research in biological, chemical physical and geological oceanography. Research in fresh and brackish water quality surveys and inland fisheries
20. SENEGAL	6	SEN (A)	Research on the biology of fish and physical oceanography.

COUNTRY	NO. OF INSTITUTIONS	NAME OF INSTITUTIONS (BY CODE)	RELEVANT PROGRAMMES (Research/Training)
		SEN (B)	Research in marine biology and conservation of marine resources.
		SEN (C)	Fisheries research.
		SEN (D)	Training and Applied research in Fisheries and oceanography.
		SEN (E)	Analysis of fish quality and other marine resources for mercury and other pollutants.
		SEN (F)	Fisheries research on the West African coast and East Atlantic tropical region.
21. SEYCHELLES	1	SEY (A)	Fishery-oriented research chemical and biological oceanography.
22. SIERRA LEONE	3	SL (A)	Physical chemical geological and biological oceanography research and training.
		SL (B)	Marine geology and engineering soil mechanics research and training.
		SL (C)	Studies of the physical and biological conditions in the seas especially as they affect the fisheries training for young scientists and technicians.
23. SUDAN	2	SUD (A)	Oceanographic research and training.
		SUD (B)	Applied fisheries research fresh-water and marine.
24. TANZANIA	4	TAN (A)	Research and Training in biological chemical physical and geological oceanography; and fisheries.

COUNTRY	NO. OF INSTITUTIONS	NAME OF INSTITUTIONS BY CODE)	RELEVANT PROGRAMMES (Research/Training)
		TAN (B)	Applied fisheries research and training.
		TAN (C)	Research and training in aspects of marine ecology, fish stocks, primary productivity and oceanography of inshore waters.
		TAN (D)	Training personnel for the coastal and inland fishery.
25. TUNISIA		TUN (A)	Applied research in marine science training courses in chemical oceanography, marine pollution and mariculture.
		TUN (B)	Basic and applied research including control of the quality of coastal waters.